

Attributes of the Homestake Mine for Investigation of Reaction-Transport Processes



- Validation of coupled reaction-transport conceptual and numerical models requires **well-controlled *in-situ* experiments** that could be sited at depth at Homestake
- The **Fe- and Mg-rich mineral assemblage** (e.g., cummingtonite, chlorite, Fe-Mg carbonates, graphite) is strikingly different from that in the rhyolitic tuffs and granites that are the host rocks for other thermal tests
- **Effective reaction rates** are controlled by the hierarchy of scale of fluid flow, geologic structure, and **mineral fabric**, all of which are very different in the highly deformed metamorphic rocks at the Homestake Mine compared to the welded tuffs at YM or that in plutonic rocks
- Reactions of **ore minerals** such as pyrrhotite, arsenopyrite, and gold with hydrothermal waters will allow for validation of numerical models of coupled water-rock interaction and metal transport

Geochemical Attributes

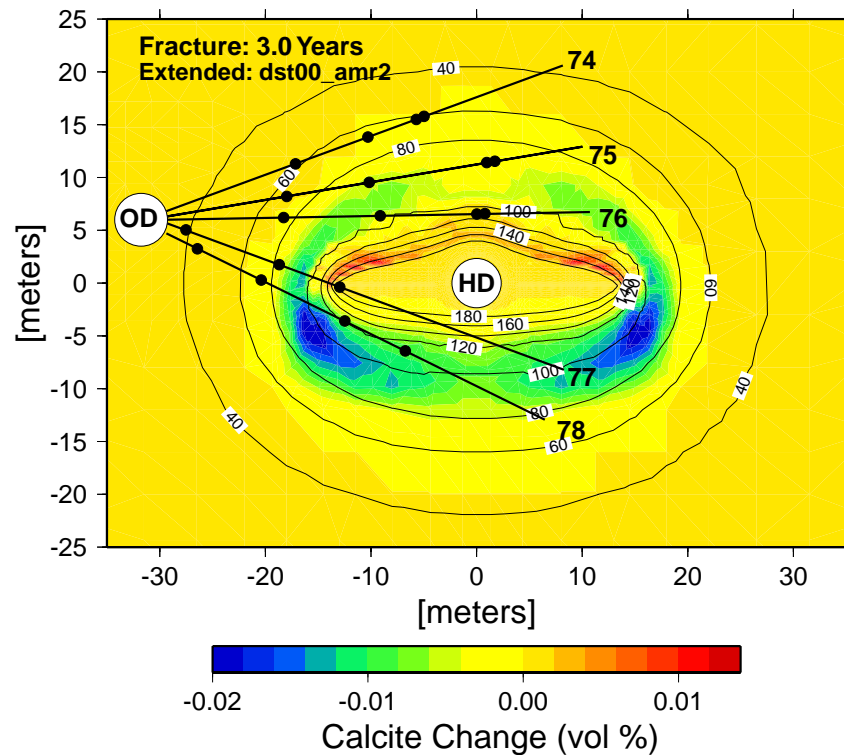


- Owing to the age of the rocks (~ 2.2 billion years old), the $^{87}\text{Sr}/^{86}\text{Sr}$ **ratios** of the minerals will be very different owing to the different initial Rb/Sr ratios. Therefore, shifts in the $^{87}\text{Sr}/^{86}\text{Sr}$ ratio in waters could be used to constrain mineral reaction rates
- For example, reaction of hydrothermal waters with **calcite** would be **rapid**, compared to silicate minerals, but would likely have a lower $^{87}\text{Sr}/^{86}\text{Sr}$ ratio owing to a potentially low initial Rb content
- Reaction-transport models of thermal tests at YM have shown areas of **calcite dissolution** strongest in areas of fracture drainage below the heaters (see following slide), which is supported by Sr contents of waters and C-14 analyses of gases. However, there is little difference in $^{87}\text{Sr}/^{86}\text{Sr}$ ratios between the waters and the calcite because of the origin of the calcite from percolating meteoric waters, and the relatively young ages of the rocks

Reaction-Transport Models and Data from YM Thermal Tests



Mineral Reactions



Gas Compositions

